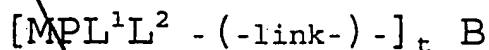


THE CLAIMS

What is claimed is:

5 1. A chemical moiety having the formula



wherein M is a lanthanide element;

P is a polydentate ligand of M;

10 L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B with at least one of P, L¹, or L², and t is an integer equal to or greater than 1;

15 B is a biological substance, a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary material, or a non-biological polymer;

20 P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

P, L¹, L², and B are of such composition that the chemical moiety can be induced to emit electromagnetic radiation.

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2. The chemical moiety of claim 1, wherein B is a member selected from the group consisting of whole cells, subcellular particles, polypeptides, proteins, nucleic acids, polysaccharides, alkaloids, steroids, vitamins, amino acids, plant pathogens, serum-derived antibodies, monoclonal antibodies, and T4 thyroid hormones.

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3. The chemical moiety of claim 1, wherein (-link-) is the linkage formed between one of said ligands and a free amino group which is part of B.

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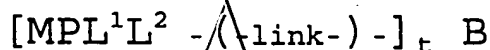
4. The chemical moiety of claim 1, wherein (-link-) is the linkage formed between a carboxyl group and a free amino group which is part of B.

5. The chemical moiety of claim 1, wherein M is europium or terbium and (-link-) is an amide linkage that covalently bonds B with a substituted bipyridyl ligand, the amide linkage being formed by reaction of a carboxyl substituent on said substituted bipyridyl ligand with a free amino group which is part of B.

6. The chemical moiety of claim 1, wherein M is europium and P, L¹, and L² are each 6,6,7,7,8,8,8-heptafluoro-2,2-dimethyl-3,5-octanedionato ligands.

7. The chemical moiety of claim 1, wherein M is terbium and P, L¹, and L² are each 2,2,6,6-tetramethyl-3,5-heptanedionato ligands.

8. A method of determining the presence of a chemical moiety, said chemical moiety having the formula



wherein M is a lanthanide;

P is a polydentate ligand of M;

L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B with at least one of P, L¹, or L²;

t is an integer equal to or greater than 1;

B is a biological substance, a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary material, or a non-biological polymer;

P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

P, L¹, L², and B are of such composition that the
5 chemical moiety can be induced to emit electromagnetic radiation;

which method comprises

- (a) forming a reagent mixture containing the chemical moiety, or the chemical moiety and an agent which upon exposure
10 of the reagent mixture to electrochemical energy forms either a reductant or an oxidant;
- (b) exposing the reagent mixture to electrochemical energy the potential of which oscillates between a potential sufficiently positive to oxidize the chemical moiety and
15 a potential sufficiently negative to reduce the chemical moiety, or to electrochemical energy such that said chemical moiety is oxidized and the agent forms a reductant, or such that said chemical moiety is reduced and the agent forms an oxidant, thereby to induce the
20 chemical moiety to electrochemiluminescence; and
- (c) detecting emitted luminescence thereby to determine the presence of the chemical moiety.

9. The method of claim 8, wherein M is europium;

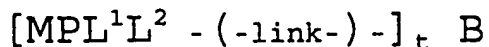
25 P, L¹, and L², each is a semi-aromatic oxygen-containing ligand, each of said ligands being the same or not the same as each other ligand; and

(-link-) is one or more amide linkages, ester or thioester linkages, or ether or thioether linkages, each said
30 linkage covalently bonding B with at least one of P, L¹, and L².

10. A system for determining the presence of a chemical moiety, which system comprises

- 35 (a) a reagent mixture comprising the chemical moiety, or the chemical moiety and an agent which upon exposure of the reagent mixture to electrochemical energy forms either a

reductant or an oxidant, said chemical moiety having the formula



wherein M is a lanthanide;

P is a polydentate ligand of M;

L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B with at least one of P, L¹, or L²;

t is an integer equal to or greater than 1;

B is a biological substance or a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary material, or a non-biological polymer;

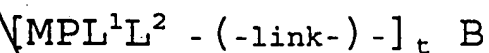
P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

P, L¹, L², and B are of such composition that the chemical moiety can be induced to emit electromagnetic radiation;

- (b) means for exposing the reagent mixture to electrochemical energy the potential of which oscillates between a potential sufficiently positive to oxidize the chemical moiety and a potential sufficiently negative to reduce the chemical moiety, or to electrochemical energy such that said chemical moiety is oxidized and the agent forms a reductant, or such that said chemical moiety is reduced and the agent forms an oxidant, thereby to induce the chemical moiety to electrochemiluminescence; and
- (c) means for detecting emitted luminescence thereby to determine the presence of the chemical moiety.

11. A method of determining the presence of an analyte of interest which binds to a chemical moiety, which comprises

(a) forming a reagent mixture comprising the chemical moiety, or comprising the chemical moiety and an agent which upon exposure of the reagent mixture to electrochemical energy forms either a reductant or an oxidant, and the analyte of interest; such that the chemical moiety and the analyte specifically bind to one another, said chemical moiety having the formula



wherein M is a lanthanide;

P is a polydentate ligand of M;

L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B with at least one of P, L¹, or L²;

t is an integer equal to or greater than 1;

B is a biological substance or a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary material, said biological substance or synthetic substance being capable of specifically binding to the analyte of interest;

P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

P, L¹, L², and B are of such composition that the chemical moiety can be induced to emit electromagnetic radiation;

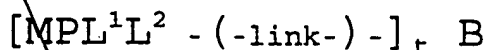
(b) exposing the reagent mixture to electrochemical energy the potential of which oscillates between a potential sufficiently positive to oxidize the chemical moiety and a potential sufficiently negative to reduce the chemical moiety, or to electrochemical energy such that said chemical moiety is oxidized and the agent forms a reductant, or such that said chemical moiety is reduced

and the agent forms an oxidant, thereby to induce the chemical moiety to electrochemiluminescence; and
(c) detecting emitted luminescence thereby to determine the presence of the analyte of interest.

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12. A composition which comprises

(i) a chemical moiety having the formula



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wherein M is a lanthanide;

P is a polydentate ligand of M;

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L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B with at least one of P, L¹, or L², and

20

t is an integer equal to or greater than 1;

B is a biological substance, a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary material, or a non-biological polymer;

25

P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

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P, L¹, L², and B are of such composition that the chemical moiety can be induced to emit electromagnetic radiation;

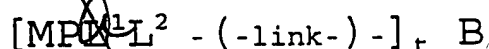
said linkages being covalent bonding linking B with at least one of P, L¹, or L², and

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(ii) one or more different chemical moieties each of which is capable of being induced to luminesce at a wavelength different from that at which any other of the chemical moieties luminesces.

13. A competitive binding method of determining the presence of an analyte of interest wherein the analyte and a chemical moiety bind competitively to a complementary material, which comprises

- 5 (a) forming a reagent mixture comprising the analyte of interest, the complementary material and the chemical moiety, or the chemical moiety and an agent which upon exposure of the reagent mixture to electrochemical energy forms either a reductant or an oxidant, such that the
10 chemical moiety and the analyte of interest bind competitively to the complementary material; said chemical moiety having the formula

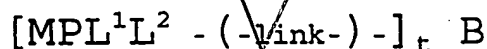


- 15 wherein M is a lanthanide;
P is a polydentate ligand of M;
L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B
20 with at least one of P, L¹, or L²;
t is an integer equal to or greater than 1;
B is a biological substance or a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary
25 material, said biological substance or synthetic substance being capable of binding to the complementary material;
P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the
30 coordination number of M; and
P, L¹, L², and B are of such composition that the chemical moiety can be induced to emit electromagnetic radiation;
35 (b) exposing the reagent mixture to electrochemical energy the potential of which oscillates between a potential sufficiently positive to oxidize the chemical moiety and

a potential sufficiently negative to reduce the chemical moiety, or to electrochemical energy such that said chemical moiety is oxidized and the agent forms a reductant, or such that said chemical moiety is reduced and the agent forms an oxidant, thereby to induce the chemical moiety to electrochemiluminescence; and
(c) detecting emitted luminescence thereby to determine the presence of the analyte of interest.

14. A system for determining the presence of an analyte of interest which binds to a chemical moiety, which system comprises

(a) a reagent mixture comprising the chemical moiety, or comprising the chemical moiety and an agent which upon exposure of the reagent mixture to electrochemical energy forms either a reductant or an oxidant, and the analyte of interest; said chemical moiety having the formula



wherein M is a lanthanide;

P is a polydentate ligand of M;

L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds linking B with at least one of P, L¹, or L²;

t is an integer equal to or greater than 1;

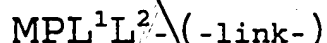
B is a biological substance or a synthetic substance which is capable of competing with a biological substance in a competitive binding reaction with a complementary material, or a synthetic substance being capable of binding to the analyte of interest;

P, L¹, L², and B are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

P, L¹, L², and B are of such composition that the chemical moiety can be induced to emit electromagnetic radiation;

- (b) means for contacting the chemical moiety with the analyte of interest to form a reagent mixture;
- (c) means for exposing the reagent mixture to electrochemical energy the potential of which oscillates between a potential sufficiently positive to oxidize the chemical moiety and a potential sufficiently negative to reduce the chemical moiety, to electrochemical energy such that said chemical moiety is oxidized and the agent forms a reductant, or such that said chemical moiety is reduced and the agent forms an oxidant, thereby to induce the chemical moiety to electrochemiluminescence; and
- (d) means for detecting emitted luminescence thereby to determine the presence of the chemical moiety.

15. A compound having the formula



wherein M is a lanthanide element;

P is a polydentate ligand of M;

L¹ and L² are ligands of M, each of which may be a substance covalently bound to one or more of P, L¹, or L² through one or more covalent bond linkages, said linkages designated as (-link-) and being covalent bonds;

P, L¹, and L² are of such number that the total number of bonds to M provided by the ligands of M equals the coordination number of M; and

P, L¹, and L² are of such composition that the chemical moiety can be induced to emit electromagnetic radiation.

16. The chemical moiety of claim 15, wherein M is europium and P, L¹, and L² are each 6,6,7,7,8,8,8-heptafluoro-2,2-dimethyl-3,5-octanedionato ligands.

17. The chemical moiety of claim 15, wherein M is terbium and P, L¹, and L² are each 2,2,6,6-tetramethyl-3,5-heptane-dionato ligands.

5 18. The chemical moiety of claim 15, wherein (-link-) contains an N-hydroxysuccinimidyl moiety

10 19. The chemical moiety of claim 15, wherein (-link-) contains an amino moiety

20 20. The chemical moiety of claim 15, wherein (-link-) contains a thiol moiety

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B⁺